PROJECT FACTS

UNIVERSITY OF KENTUCKY
CENTER FOR APPLIED ENERGY RESEARCH

VALUE-ADDED CARBON PRODUCTS FROM PCC AND IGCC BYPRODUCTS

The need to reclaim ash-pond land from existing Pulverized Coal Combustion (PCC) power plants is becoming critical as the availability of landfill diminishes and energy demand continues to rise. A technology developed at CAER to recover carbon from utility ash ponds and landfills has shown these ponds to be a valuable source of marketable carbon. This technology applied to the next generation of coal fired and integrated gasification combined cycle (IGCC) power plants, has the potential for yielding value-added carbon products from their waste streams. Pilot-scale testing has recovered coarse and fine carbon products with grades as high as 70% and 60% respectively. Charah Environmental, Inc. operates a by-product processing facility designed by CAER at the Polk Station IGCC power plant which produces 400-600 tons/day of a high carbon slag/char product.

The project's purpose was to investigate the suitability of recovered carbon from PCC and IGCC power plant wastes as marketable value-added carbon materials. Carbon fractions separated by the technologies developed at the CAER were evaluated for their potential to serve as adsorbents for Hg and NO_X adsorption and as fillers for plastics for electrostatic discharge control applications. The recovered carbons were subjected to steam and chemical activation. Mercury and NO_X adsorption potentials of the PCC and IGCC carbon fractions, their activated carbons, and commercially available specialty carbons, were determined and compared. The PCC and IGCC recovered carbons were also blended with polypropylene, thermoformed into film, and tested as a filler to impart electrical conductivity.

Results indicated the carbon fractions had the potential to serve for Hg and NO_X emissions control, but did not have sufficient conductivity for use as electrical fillers. Untreated gasifier char carbon was found to be as effective at capturing Hg as a commercial specialty activated carbon designed for Hg adsorption. All attempts to improve the porosity of the recovered IGCC carbon decreased its Hg adsorption potential. The need for no further treatment of the IGCC carbon fraction would decrease the cost of using the material for Hg flue gas emissions control. Both untreated and activated PCC carbons had little Hg adsorption capabilities. The data indicated that Hg adsorption on the gasifier carbon was related to its mineral content, primarily SO_4^{-2} and Cl^-.

IGCC carbon adsorbed significantly more NO_X than the other test materials except for a specialty activated carbon developed for NO_X adsorption. Increasing the surface area of the recovered carbons by activation increased the NO_X adsorption capacity and Hg laden IGCC carbon adsorbed more NO_X than Hg-free carbon. This suggested that Hg and NO_X were adsorbed at different active sites on the carbon. Pore-size distributions of the Hg laden and Hg-free IGCC carbon indicated an increase in micropore volume as Hg partially occupied mesopore spaces. This is consistent with the mechanism of NO_X adsorption on carbons which is known to involve micropores. The best NO_X adsorption on the IGCC carbon was 30% that of the specialty activated carbon. Therefore, if the IGCC carbon were used for Hg flue gas capture, it additionally has the potential to reduce NO_X emissions of a primary NO_X control technology.

These results show that one sorbent could be tailored for both Hg and NO_X adsorption and that carbon separated from IGCC wastes could serve as an alternative to more expensive specialty carbons for Hg capture from utility flue gas.

PARTICIPANTS

University of Kentucky
Center for Applied Energy Research
2540 Research Park Dr.
Lexington, KY 40511
Completed 2/17/04

Charah Environmental, Inc.
2266 Anton Road,
Madisonville, KY 42431

SPONSORS

US Department of Energy/Consortium for Premium Carbon Product from Coal
UK CAER
Charah

COST SHARING

DOE-CPCPC…$70,000
UK CAER……..$60,642
Charah………..$10,000

CONTACT

Aurora Rubel
UK CAER
2540 Research Park Dr.
Lexington, KY 40511
Tel.: (859) 257-0209
Fax: (859) 257-0220
rubel@caer.uky.edu